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A Greedy Approach to Cooperative Indoor Localization

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ABSTRACT

We present a cooperative approach to indoor localization that laterates using recursively calculated distances to anchor nodes. It achieves high precision in any sufficiently dense network constellation. We tested using several lateration algorithms – basic trilateration, LLS, NLLS and AML.

The core of the algorithm consists of nodes recursively estimating their distances to anchors by accumulating their neighbors' estimated distances to the anchors with their own distances and choosing the shortest possible distance to each anchor, making the strategy greedy. Localization is then carried out using the true anchor positions in conjunction with the accumulated distances to these anchors. Two problems arise from this strategy: The first is clustering, meaning that groups of nodes localize among themselves without any connection to a minimum number of anchors, rendering the position estimates unusable. To prevent this, we implement a Quality of Service metric that makes nodes choose only neighbors with a better hopcount than themselves. The second problem is that the recursively estimated paths to the anchors will never be perfectly straight, resulting in higher distances than with a theoretical straight line. However, our results show that the benefit of laterating with true anchor positions instead of estimated positions of one-hop neighbors outweigh these drawbacks.

We compare our algorithm to the traditional approach of just laterating with neighbor location estimates using the JiST/SWANS simulation environment. The tests were run with three to five static anchors and varying numbers of mobile nodes on a 150x150m² field, with a simulated distance error consisting of 30% non-line of sight-errors. The average position error of our approach proved to be much better at the beginning of the simulation, with the traditional approach gradually reaching a similarly good level, finally resulting in the greedy approach being 0.5 to 1.5m better.

We propose our algorithm as a viable alternative to the traditional approach as it proves to be consistently better in dense network configurations.

KEYWORDS: Cooperative Localization, Wireless Sensor Networks, JiST/SWANS, Simulation